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**Press Briefing**

**"NASA to Provide  
Mars Science Laboratory Launch Update"**

Briefing Participants:

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**ED WEILER**, Associate Administrator,  
Science Mission Directorate, NASA  
**DOUG McCUISTION**, Director,  
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Moderated by **DAVID MOULD**,  
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## P R O C E E D I N G S

MODERATOR: Good afternoon, and welcome to NASA Headquarters in Washington. I am David Mould from NASA's Office of Public Affairs. Thank you for joining us today for our latest update on the Mars Science Laboratory Mission.

We have a lot to cover today before we open it up for questions. So let me first introduce our speakers. First, we have the Administrator of NASA, Michael Griffin; Ed Weiler, the Associate Administrator for the Science Mission Directorate here at NASA Headquarters; Doug McCuistion, Director of the Mars Exploration Program, also here at NASA Headquarters; and Charles Elachi, Director of the Jet Propulsion Laboratory in Pasadena, California.

We will start with some opening remarks from these gentlemen, and then we will go to questions both from here at Headquarters and from people who are assembled at the NASA centers across the country.

So I will now introduce the Administrator of NASA, Michael Griffin.

ADMINISTRATOR GRIFFIN: Thanks, David. Good afternoon to all of you, and thanks for joining us.

Today, we are announcing a delay in the launch of Mars Science Lab. Because of a number of factors that need to be addressed, we are slipping the launch of MSL to 2011.

As many of you know, this mission, which is designed to assess whether the Martian environment is or ever was able to support microbial life, had been scheduled for launch in the fall of '09, but because of problems principally with the Rover's actuator motors, but also because of a rather extensive backlog of other work, we will not be ready to launch by the hoped-for date next year.

Despite the delay, work on the mission really is progressing well, with the exception of the motor problem, which we just do not yet adequately understand.

I have full confidence in the JPL team to be able to work through the difficulties, but we have determined that trying for '09 would require us to assume too much risk, more than I think is appropriate for a flagship mission like Mars Science Laboratory.

If we could delay the launch for a few months, we would, and that would probably take care of it, but launch opportunities for Mars don't allow that. They come every

26 months, and so we either go in 2009 or 2011.

We are meeting with all of you today because we are aware that MSL has been much in the news lately. A mission like this ranks just behind a manned mission in importance, and we want to be straightforward and open with you when we have news to report, whether it is good or bad.

So we look forward to answering your questions in just a few minutes, but first, I would like to introduce NASA's Associate Administrator for Science, Dr. Ed Weiler.

Ed?

DR. WEILER: Thanks, Mike. Good afternoon, everybody.

Let me put today's decision in context by taking you back to early October of this year. We had a major review of the Mars Science Lab, MSL, and the conclusion of that review, the JPL project and program and independent technical review team was that we had a solid chance of making a 2009 launch, if we could extend the launch window about three weeks, which we did to mid October, and if we could add about \$200 million to cover the additional manpower to maintain schedule.

We could have made the decision at that time

delay for 26 months, but making that decision then would have automatically added much, much more cost in the out-years of the program.

But -- and this is very important -- we did not give an unrestricted go-ahead to launch in 2009. We put in place a major progress review with the Administrator on January 5th, 2009.

Why that time frame? If we had not made sufficient progress to that point, we could then make the decision to slip, slow down the project, and live within the current 2009 budget and thus not incur the additional \$200 million in cost, but Mike and I went further than that.

To ensure the goal of staying within that 2009 budget if we decided to slip, we had the project provide us with a series of milestones week by week in November and December that we could monitor weekly to judge whether we are making the required progress toward that January meeting.

As of yesterday, the project, the program, independent review team, and the JPL independent technical authority all agreed unanimously that MSL could not make

the 2009 launch schedule. This was based on slipping deliveries, new technical problems, and erosion in the schedule reserve.

Mike and I accepted this advice, and we are going to rephase MSL for a 2011 launch. This will allow for careful resolution of any remaining technical problems, proper and thorough testing, and avoiding a mad dash to launch. Failure is not an option on this mission. The science is too important, and the investment of American taxpayer dollars compels us to be absolutely certain that we have done everything possible to ensure the success of this flagship planetary mission.

One of the questions I am sure will be what impacts will this have on programs in '10 and '11. We obviously haven't had enough time to fully evaluate that, but from the evaluation we have been able to do to this point, we don't think we will have to cancel any programs in 2010 or '11, but, of course, there probably will have to be some schedule delays in programs.

The impacts will come from Mars first, and if there is not enough in Mars, we will have it impact some planetary programs. When we work up those options, we

will, of course, take those options and the impacts to the scientific community.

We have an independent advisory structure here at NASA called the NASA Advisory Committee, the NAC. They have a subcommittee called the Planetary Science Subcommittee. We will take those options, those impacts, and share them with the community through that process to get their best advice, and we expect that to happen fairly soon. I don't have a timeline because, as I said, the decision to delay was yesterday, but we will do that as expeditiously as possible.

So, to give you more details, I will throw it to Doug McCuistion, who is the Mars Program Director here at NASA Headquarters. Doug?

MR. MCCUISTION: I am going to talk a little bit about the technical and financial situations that have gotten us here, but first, I would like to set some context for the progress we have made on this mission.

As Mike pointed out, we are really only a few months behind schedule, not two years behind schedule, but, unfortunately, planetary alignments push us into a 26-month set of opportunities, and that is the prudent thing to do

here.

So, if I could have the first graphic, please.

This is really three missions in one. This is a very complicated system. I know we hear the word "complex" and "complicated" almost overused. I want to give you an idea of what that really means.

This is the Cruise Stage. This Cruise Stage is probably on the order of 25 feet in diameter. This is what keeps the spacecraft alive on its journey to Mars for nine months. This is probably of the class of an Explorer's class mission all on its own, quite a complicated piece of equipment.

Next graphic, please. I am going to scoot through these pretty quickly.

This is the Descent Stage, otherwise known as the Sky Crane. This is amazingly complex. Typical spacecraft have propulsion lines that are roughly the diameter of a pencil. This has propulsion lines that are roughly an inch in diameter, and there are several gradations below that. So this is an incredibly complex, first-of-a-kind piece of equipment.

As you can see, it is basically done, as was the

Cruise Stage. This is probably a Discovery-class mission all by itself. It is quite a complicated piece of equipment.

The next one, next graphic, please.

This is the Rover, which you can also see is largely assembled. To give you context on size, Jamie, who is the Lead Mobility Engineer for the Rover, is sitting in front of this. So you can see how large this is, and I will show you in a second how this literally dwarfs anything we have done before.

Why does it have to be so big? Number one, two years mission life on the surface. Number two, it is carrying a chemistry suite. It is a small chemistry lab, a pair of them actually that are embedded inside this Rover to be able to process samples and use the analytical instruments that are in it. You need a certain size and certain capability, and of course, it is a redundant system because it is a flagship mission. This is, again, a very complicated system and Discovery class or better.

Next graphic, please.

This is called the Stack. We have made, as you can see, an enormous amount of progress. This spacecraft

is largely complete. There are a handful of items that aren't, but this spacecraft in that assembled configuration -- the Rover is inside the aeroshell -- is headed into environmental test for Launch Cruise this week, as a matter of fact, and that will continue. We want to understand and ring out that system as best we can before we go any further.

Next one, please.

This is our family, extended family, obviously, but to give you a feeling of context and size, you can see the Pathfinder was about 24, 25 pounds. It carried a small amount of instruments. It was really pretty rudimentary. It taught us how to get to the surface and how to work on the surface.

Spirit and Opportunity is to my left on that image. It is significantly larger, and we keep the same payload mass. Roughly about 10 percent of the overall system mass is payload, but when you move that to the kind of payload necessary to do the science that Mars Science Lab is going to do, you end up with a fairly large system of nearly a ton, as you can see.

I believe that is my last graphic.

So the issues have really boiled to -- the technical issues have boiled down to two categories. One is development delays and relates to schedule, the other is test and rework.

As Ed said, the test has to be thorough. To do the test as you fly in the fashion that we really think is appropriate for a mission of this caliber, you don't want to compress your assembly test too awfully much, and that is actually where we ended up.

We have had development delays in avionics from a maturity perspective. Motor controllers, those are the electronics that actually drive these actuators. As Mike mentioned, the actuators themselves have been difficult not only from the perspective we have anomalies, problems that we don't understand the cause of yet, down at temperatures like minus-50 and minus-70 degrees Centigrade, which is where these will operate, but we haven't understood the root cause of those yet. And the throughput at the factory has been difficult, considering all the problems.

Sample handling is extremely challenging, and maybe some of you remember Phoenix and the difficulty with Phoenix in handling samples. We want to make sure the

sample handling systems are actually rung out extremely well and we understand how well they work or repair things that don't.

As far as test and rework, we found things along the way, whether it is resistors that need to be replaced, propulsion wells that need to be fixed, or solar arrays that need some rework on the cells that just compound the problems. We need a more measured approach to resolving the problems and getting the tests done to make sure we have a robust system that we are going to fly to the planet.

As Ed said, failure is not an option, and the way to prove that is to test it within an inch of its life, if you will.

And frankly, Phoenix is a good example of that. Phoenix was canceled in 2001 by Ed, I believe, and I'll tell you, when we brought it back as a scout mission, the majority of its development time was in test. We found numerous, more than 10 problems, that were never identified by the failure team, that were found in the extensive test program we put together on Phoenix, and of course, it made it to the surface successfully and has been a fantastic

mission. I think it is hard to argue with that.

So I know everybody wants to know how much this is going to cost. So I am going to start kind of back at the beginning a little bit, give you a little cost history to tell you then where we are going to be, at least where we think we are going to be.

To set the record straight, the first commitment to cost that this agency makes per the processes that this agency has held for many years is at what is called the "confirmation review." That is at the beginning of development. That is the approval to actually go start cutting hardware. That was in August of 2006.

That commitment was made at \$1.63 billion, life-cycle cost. No previous estimate before that was agreed to or supported by the agency.

Started seeing problems at the CDR, which was in basically the middle of 2007. We worked with the project.

The project in the center came in, asked for some financial support for a couple of years -- I'm sorry -- for a couple of times in that year, which we accommodated.

The current level that has been approved by the agency is \$1.88 billion, life-cycle cost. That is a

15-percent cost growth, 15 percent.

The slip to 2011 is essentially going to cost us in the range of \$400 million. What does it cost so much? We are adding a couple of years to the mission. There are operations costs in years that we didn't expect MSL to be operating any longer. So we have to add those funds. The total at the end of that is in the order of 2.2- to \$2.3 billion, life-cycle cost.

Those numbers, as Ed said, are not firm, were not complete. That is a thumbnail from the project and program office that we have gotten recently, and detailed grass-roots work will be done over the next month or two before we make any commitments to final cost.

So, as Ed said, right now there will be some pain in planetary and in Mars to help pay for this. Mars will pay back those who need to contribute to help us get through this. The previous AA recommended a significant reduction in this program in '09, '10, and '11. So I don't have the funding available right now to pay for this, unfortunately. So we will have to do paybacks.

No cancellations are expected, but this is the right thing to do. It is absolutely the right thing to do

to make sure that this mission to conduct the science that is appropriate is tested thoroughly, is well understood, and that we take the appropriate time to do this before we launch this.

So, for more of the center perspective and where we go from here, Charles?

MR. ELACHI: Okay. Thank you, Doug.

First, let me start by saying there is nobody, there is nobody who would love to launch this thing in '09 than the team which is working on it.

We gave them one of the most challenging missions, probably the most challenging mission that JPL ever had undertaken. We put the best teams -- probably the only team which can do it. These are the people who brought us three successful landings in the last five years. These are the people who put the face of NASA across the world on the front of the newspapers.

They have worked their tail off over the last four or five years to make this happen, and I think they worked in the best spirit of NASA, an American spirit of taking a lofty goal and try to work very hard to achieve that goal.

Unfortunately, despite the full support by NASA Headquarters, by the NASA centers, by our contractors, by the academic community who worked with us, we just came a little short, and in the case of Mars, it doesn't matter if you are one day short or one week short or a month short. You have to wait 26 months, as Mike said earlier.

Clearly, the team is disappointed, but we are not disheartened, and I want to say that what I admire particularly about the team, living in the spirit that Mike Griffin insisted at NASA as the highest level of technical integrity. Despite their love of flying this mission in '09, they stood up and said, "Look, after we tried everything, we really don't think it is a good idea. This is not the right idea. This is not the smart idea to continue in '09 because Mars is very unforgiving.

So they first recommended that we ought to come back to Headquarters and recommend delay for that mission.

I as an independent authority at JPL, I reviewed the program. I had people from outside the project, as well as from outside MPL come with us and look at this to see if there anything we missed that we could do that we have not done, and based on that assessment, I recommended to NASA

also as an independent authority that the right thing and the smart thing is to delay this mission to launch in 2011.

Now, where are we today, and what are we going to be doing in the near future? First, as you saw from what Doug presented, the vast majority of the hardware has been built and completed. When you look at the hardware, this is a Cassini class, Cassini size, Cassini complex mission, and for a bonus, we have to land it on another planet. So that kind of gives you the idea of the challenge that the team has risen to.

So what we are doing now, we started doing the testing. We are starting to understand pretty well, the issues, the technical issues which are in this whole system as we are integrating it together. So the plan in the near term is to, one, understand the technical issues and look at solutions for them and do a very comprehensive test program, test as you fly, test as you fly, test as you fly.

As was said earlier, Mars is an unforgiving planet. You just can't only rely on luck to be able to successful. We can capitalize on luck, but we cannot plan for the luck.

And here I want to say one thing which is very

critical. If we would have delayed this program six or seven months ago, like some people said, or two months ago when we came to NASA and they gave us a chance, probably we wouldn't have understood the technical challenges that we have now because we would have slowed down and not completed the hardware and done the testing.

So, by Headquarters giving us the opportunity to keep proceeding, actually it allowed us to understand all the quirks and issues that we have. So we can do a plan from here on of how to do the testing and to project also the cost beyond here.

And I have to say we have not been good at doing cost estimates. I take responsibility for that. This has been just a very complicated mission. We extrapolated from our past experience, but when you are doing something for the first time, which is literally an order of magnitude more complex than what you have ever done before, extrapolations sometime doesn't work exactly like you would like it to do.

So, in closing, I want to say the team is committed to strive to achieve mighty things for NASA and for the country. As I said, they are disappointed, but

they are not disheartened on doing that, and with the support of NASA, we are not sitting in the twilight. We are going to reach again for another high and really make this mission successful, and hopefully, we will all be sitting in the mission operations when we land this mission successfully.

Thank you.

MODERATOR: Thank you, gentlemen.

We are first going to go to questions here at Headquarters. We have got some folks with microphones. If you can wait for them to get to you, identify yourself, and say your question is directed to, and the same with the folks at centers on the phone.

So let's start right here, please.

MEDIA QUESTIONER: Hey, guys. Mark Mathews with the Orlando Sentinel. I guess a question for Doug.

With most of the material already build and assembled, why does it cost \$400 million to push this off into the future? Could you break down that cost for me?

MR. McCUISTION: Yeah, I can give you some idea of that.

Remember, if we had launched in 2009, the money

that is available in the budget is only operations money, which is not a significant amount of money, frankly, in this vain.

There is a team that is required to test the system, and there is a team required to assemble it and then ship it to the Cape to go through Thermal Vac because we go through multiple Thermal Vac cycles and multiple vibration cycles. When you first do the Launch Cruise environment that I showed you the Stack, we then take the Rover and do surface environments. So, unlike an orbiter, this thing actually goes through a couple of rounds of environmental tests.

Of course, then you have the Cape operations. Since there is a Multi-Mission Radioisotope Thermoelectric Generator on board, an MMRTG on board, you also have a different flow of processing which takes a few more people to handle this device down at the Cape and on the launch vehicle.

So there is a certain level of staffing required to put a system of this size and complexity through its test paces. Plus, we also have to solve a number of these problems we haven't quite gotten to the end of yet.

So the bulk of that 400 is in fiscal years '10 and '11, which is the remainder of the development cycle, and then, of course, in the out-years, in '13 and '14, we didn't expect to have MSL operating, at least we don't budget it within the project line. It goes into an extended mission line if it is still operating. So we had to identify operations money for those years.

So that is the breakdown. That is how it works.

MR. ELACHI: Can I add one thing?

MODERATOR: Yes.

MR. ELACHI: I am not going to quote specific dollars, but considering we have -- as I said earlier, Mars is very unforgiving, and landing on another planet is very, very complicated. It might look easy on TV when you see the landing, but it is a very complicated endeavor.

So, as long as we have the hardware on the ground, it will be wise for all of us to continue doing the testing and do as comprehensive tests as we can because that will improve the likelihood of success.

MR. McCUISTION: Yeah. It is not like it is going in a big plastic bag and sitting in the corner for two years. That is not the case.

MODERATOR: Okay. Keith.

MEDIA QUESTIONER: Keith Cowing from  
NASAWatch.com for Ed Weiler.

Given that you disbanded or NASA disbanded the "Cost to Go" team earlier this year, which was raising these issues, do you in retrospect think that you should have kept it in place, especially since with these numbers here, 6-, \$700 million, you are in Nunn-McCurdyville in terms of, you know, the reports and reviews that you need to provide?

DR. WEILER: First of all, I am not aware we disbanded any teams, but that was before my time.

So, Doug, what did you do or not do?

MR. MCCUISTION: What did I do or not do.

[Laughter.]

MR. MCCUISTION: Well, what I didn't do is disband the team.

Actually, part of that team was already part of our independent review team, Keith. They are still in place. We offered opportunities for everybody -- and most of them took it -- from that team -- I will call it the Ken Schwarz [ph] team because he was the chair of that -- to

join the standing review board, which they did. In fact, Ken Schwarz is still on the standing review board and helping it. So that team was not disbanded.

And by no stretch of the imagination were those teams' inputs disregarded. They were taken extremely seriously, all the way to Mike's level.

ADMINISTRATOR GRIFFIN: We didn't not take the Cost to Go seriously. In fact, we started budgeting for the Cost to Go --

MR. McCUISTION: That's right.

ADMINISTRATOR GRIFFIN: -- to get to '09 if it could be done. We undertook a round of discussions with the OMB, which, of course, gets involved when we talk about reprogramming money to that level, and we have discussed it informally so far with the Hill to try to explain to people that we might be having to find more money from our science lab, but that launching in '09 was still going to be the cheapest option.

MR. McCUISTION: That's right.

ADMINISTRATOR GRIFFIN: So far from ignoring Ken -- Ken Schwarz is one of the better program managers NASA has. Far from ignoring those recommendations, we took

them.

MR. McCUISTION: We acted on them.

ADMINISTRATOR GRIFFIN: Yeah.

MR. McCUISTION: And frankly, we were supported by what he said by Congress and OMB and everyone else. We solved a significant financial issue to get them through '09, which was one of the recommendations -- which was the recommendation actually of that panel, which was to continue.

ADMINISTRATOR GRIFFIN: So I'm not sure where all that is coming from because we took those recommendations.

Now, the decision to slip to '11 is not because we couldn't find the money. The decision to slip to '11 is based, as Charles and others have said, on a total amount of work yet to go to get to the finish line, but principally, if you had to pick out one thing that says I just don't want to try to do this, we know that these actuator motors must work on Mars, and we have got some anomalies in some of them, not all of them, a couple of them that we don't understand.

The understanding could emerge a week and a half from now, but we can't predict that, and if I can't predict

a date when we are going to understand this thing, this phenomenon that we don't understand today, then we are not going to gamble on launch at this point, but we are not slipping because of money.

MR. McCUISTION: No, not at all. In fact, I would like to add one thing to the actuator comment. We have not yet started life tests of these actuators either, and the reason we haven't started is because we don't have a solid reliable unit yet. If we don't understand how long these live, we could put them on the surface, and unlike MER, whose actuators have lasted five years, these could last two days, three days, five weeks. We don't really have any idea, and that is just not an appropriate or reasonable stance to take when you are spending the taxpayers' money.

MODERATOR: Seth?

MEDIA QUESTIONER: Seth Borenstein, AP, with a two-part for Administrator Griffin.

First, if you are looking at \$400 million, I know you don't have the specifics yet, but that is about the size of, well, what used to be a small -- you know, what would be a small program in NASA.

Are you looking more toward across-the-board-type little things here and there or just saying okay, Mars is going to feel the pain, out goes this mission or out goes that other mission? In other words, what is your strategy?

And then the second one is putting it in bigger perspective. You have got James Webb which has even a bigger overrun here according to some people. You have GAO saying \$230 billion for Constellation coming up. You want to pay nearly \$50 million a head for your astronauts to -- on Russia. What kind of financial shape are you giving the next administration in terms of NASA, and have you warned them about the budgetary pitfalls that seem to be everywhere?

ADMINISTRATOR GRIFFIN: Gee.

[Laughter.]

ADMINISTRATOR GRIFFIN: Interesting tone to your questions there, Seth. Let me take the easy one first.

\$400 million is about what we would spend on something like a Discovery program. You're right. Of course, we don't spend it all in one year, and we won't find all of this money all in one year. I don't know yet.

I think Ed and Doug both said we think we can get

by without canceling anything with delaying some stuff, and that is going to be our plan. I will review the recommendations and approve them before they go forward, but we are all in this together. So we are going to find the least damaging way that we can, and we are going to discuss what we come up with, with our advisory committees.

So this is math that we will be doing in public.

We just don't have the answers for you yet.

Now, I disagree that JWST is overrun. JWST is executing very well. It is another of these very challenging flagship projects. It is another case where we are doing something we have never done before, but I can't speak well enough for Phil Sablehaus and the team at Goddard that are running it and the folks at Northrop Grumman who are executing on NASA's program. They are doing well. That is not a prediction that they will not encounter any trouble, but as of now, they are doing well.

James Webb will cost substantially more than the figure at which it was sold by the science community to my predecessor at least one removed.

I am sure all of you will be shocked here to know that scientists sometimes advertise their capability to do

a mission for less than it really costs.

[Laughter.]

ADMINISTRATOR GRIFFIN: But the mission is not overrunning.

It is possible there is some confusion out there.

One of the things I did a few years ago was to instil what is called probabalistic budget estimation within the agency confidence level, budgeting in shorter form, and we have adopted that for as many of our older programs and all of our new ones as we can, and we are budgeting our science programs to a 70-percent confidence level.

That requires some readjustment of the funding we chose to allocate based on the use of industry standard cost models to estimate what they would cost, but by no stretch of the imagination is it fair to say that James Webb is overrunning at this point. It is just not.

Now, you mentioned what else. Let's see.

Pardon?

MEDIA QUESTIONER: Constellation, \$230 billion.

ADMINISTRATOR GRIFFIN: Yeah, the GAO, \$230 billion. Look, you might just as well say that we are going to spend a trillion dollars or \$100 million on

Constellation.

Constellation is the manned space flight program of this agency when Space Station is completed and Space Shuttle is retired.

We spend about 60 percent of our budget year in and year out on human space flight. So you can get any figure at all that you would like to have for how much the nation spends on human space flight by picking the time frame that you want to discuss. This is an agency. This is the agency in the United States which does human space flight, and we spend about 60 percent of our budget each year doing it.

What we should discuss is what we are accomplishing with that money. I think we are accomplishing great things in finishing up the Station with the efficiency that that is being done.

I have said over and over again, and I am happy to say it one more time. I think the President got it right. The '05 Congress got it right in their Authorization Act, and in '08, the Congress got it right again with their Authorization Act specifying what it is that we should do with the money that we spend on human

space flight, but to attach a price tag to what we spend on Constellation implicitly carries with it a time frame.

I hope no President and no Congress ever puts the United States out of the human space flight business, and as long as we are in the human space flight business, NASA is going to spending about 60 percent of its budget doing it.

So I am trying to be responsive to your comments, but I think you are using the wrong measuring scale. As far as \$50 million a seat for astronauts to fly to Station on Soyuz, I don't actually know that that is the number off the top of my head, but accepting your figure, you know it is a seller's market right now.

As a matter of national policy, the President recommended and the Congress approved by means of its budgetary deliberations. Each and every year for the last several years, the Congress has decided that we will have a gap in U.S. human space flight capability between the end of Shuttle and the initiation of Ares and Orion. That is a matter of national policy.

Our alternative way -- and I am glad we have one. I am glad we have Russian partners to fall back on, but

our policy has been for several years now that we will buy rides from Russians to convey our crew and those of our international partners to the Station. So this is not a surprise to anyone, nor is it a surprise to anyone that I will say for about the 500th time that I don't like it, but I don't like it less than I don't like not flying at all. So that's what we're going to do.

MODERATOR: Mark, back here, please.

MEDIA QUESTIONER: Thank you. Mark Kaufman with The Washington Post.

There is a lot going on now in terms of what you are learning about Mars from Phoenix and from other things, other data that is coming in. Is it --

ADMINISTRATOR GRIFFIN: It is when we do it.

MEDIA QUESTIONER: Right. But my question is, is it possible that with this additional 26 months that you are going to find a need for other kind of instruments? Is there any possibility of that?

I know that there is a process going on now in terms of where you are going to land. What is going to happen with that process? Is that open for further and further review? Is this an opportunity to kind of upgrade

the mission in addition to work out the difficulties?

MR. MCCUISTION: Let me hit landing sites first.  
That is probably the easiest.

We have had a process in place for a couple of years now that has been working incredibly well on landing sites. We are down to four key landing sites. Those are unbelievably compelling landing sites, and they range from significantly south of the Equator to north of the Equator and one that is almost on the Equator.

I don't think that there is a need to go back and reopen that dialogue. This was thoroughly vetted with the community numerous times in public, and I don't think that we would see a reason to change any of those landing sites.  
So I am not expecting that.

Instruments. If I have a program science group of 20 folks, I will probably 50 instrument ideas. Every day, there is a new idea for an instrument. Can we put them on? No. Is this an opportunity to upgrade the mission? No.

This was an incredibly, carefully thought-out mission and instrument suite by the science community over the years of formulation of this mission, which started in

2003 and basically went through '06.

Five flight instruments have already been delivered. The others are very close to delivery. I think we will have them all by the end of January.

There may be a few things to make them more reliable that we want to look at, but as far as mission upgrades, there are none planned, and we don't want to do that.

We also want to keep the cost of this down. Obviously, we work very hard and the team worked very hard not to slip to '09. So opening the door to massive upgrades is just not in the cards. It is not appropriate either because you may mess up a carefully orchestrated instrument suite if you did that anyway.

DR. WEILER: Let me take your question a little bit further. The delay will be something else that is an opportunity.

David Southwood, who is the director of Science at ESA, the European Space Agency, is my counterpart there.

Back in July, we had our annual bilateral meeting between our staffs, and David and I in a private meeting started chatting about the fact that they had not orbited Mars.

They have a very successful Mars mission right now. They have large ideas of what they would like to do, but as is in the case of the United States, these missions get more and more expensive.

The easy stuff has been done. The flybys have been done. That's the easy stuff. When you get into orbiting and landing on things, that is when it gets tough, and it gets expensive.

So David and I sort of talked about the possibility that maybe we ought to think about NASA and ESA getting together and come up with one Mars architecture, one Mars program for the Earth, so to speak.

So we started talking about that. He took that back to the European Space Agency, and just by curiosity, we had another meeting yesterday, just before this, about the final decision here, but I shared this information with him.

He has now gotten approval, and I am allowed to say this, that in the future, NASA and ESA are going to look together to come up with a European-U.S. Mars architecture. That is, missions won't be NASA missions, they won't be ESA missions, they will be joint mission. We

need to work together. We will never, ever do a sample return mission unless we work together, and we both have the same goals scientifically. We want to get our science communities together and start laying out an architecture.

We now have that time, for all the wrong reasons, but we now have that time. We don't have to rush to come up with some idea for 2016. They have got some ideas; we have got some ideas. Let's work together. We know how to land things on Mars. They know how to orbit things on Mars. They have launch vehicles; we have launch vehicles.

So this makes immanent sense to both of us, and we committed to each other to get our communities to start working toward that goal.

MR. ELACHI: One thing, just to emphasize what Doug -- almost all the hardware is built. This is a very complicated mission, and Mars is a very unforgiving planet.

The best thing is to focus the next two years on really understanding the present system, testing it and testing it, so we are successful.

Any change, even from a year or two years ago, any upscope or descope is the worst thing you can do because, effectively, all the hardware is designed to

interface. All of them have been done. Now we are focusing on testing them and understanding them.

MODERATOR: Okay. We are going to switch to the Johnson Space Center in Houston for one question. Then we will come right back, so JSC.

MEDIA QUESTIONER: Thank you. It is Mark Carreau from the Houston Chronicle. I have a question and a follow-up.

I wonder if you could delve into the technical issues just a little bit more, especially this actuator issue, why it is so important, what they do.

MR. MCCUISTION: Certainly. The actuators, it is a fancy name for a motor in a gear box. So they are actually a very complicated device.

We have flown them. Actually, all of our landers have had robotic actuators of some sort. They basically do almost everything that the Rover has to do. They drive the wheels. They stop the wheels. They are the elbow and shoulder and wrist joints for the robotic arms. So, when you see a robotic arm going out and moving around, an actuator, which is a combination of a motor and a gear box, are driving those.

So the drills and the sample handling devices, all the small motors and things, there's multiple sizes of these, and that is why they are absolutely crucial to the success of this mission.

If we get to the grown, we can't move, we can't put the arm out, and we can't sample, we basically have a metric ton of junk on the surface. So actuators are absolutely crucial to any landed mission.

The problems partially are related to the fact that these are very complicated. Some of the issues has been throughput, just the ability to manufacture these at the pace we need to manufacture them. I've got a couple of numbers here, to make sure I had them. There are 31 flight -- in the Rover, there were 31 different actuators in there. So we are building 60 flight actuators and 45 engineering model actuators. That is a significant number of these highly complex mechanical devices to build.

We have had issues that have related to workmanship where we have had bearings that may not have been put in exactly correctly. We have had issues with cold encoders which tell us where the gear box is as it turns and some sensitivity electronically to those.

Our recent issue -- and this is the one that Mike alluded to that we actually don't really understand the cause yet -- is actually the braking mechanisms, and the fact that we have had a drag torque problem and a brake release problem, and we don't understand why we are having this high torque issue with these actuators.

So the criticality of the actuators, the number of the actuators that we have to have, and the fact that we have to life-test these things before we fly them and have confidence in them, that kind of wraps the actuator issue up.

MR. ELACHI: I would add two pieces of information. One, these actuators are much more massive or complicated than what we had on MER because this is a Rover which is almost eight times bigger.

Another one, just to give you a feel, some of these actuator motors have 500-piece parts. So this is not like just two pieces you put together. These are a fairly, very sophisticated, and technically challenging kind of actuators.

MEDIA QUESTIONER: Thank you.

MODERATOR: Okay. Mark, a follow-up.

MEDIA QUESTIONER: On the launch windows, I am wondering if you could just review what the '09 launch window was, kind of the open and close, and do the same thing for what you are looking at for 2011.

Thank you.

MR. MCCUISTION: The 2009 launch window was set originally as the 15th of September to, I believe it was, the 4th of October, I believe it was.

In October, the project requested some additional schedule margin. So we worked with our launch vehicle providers in Space Ops and have opened the window to 8 October to the 28th of October, I believe it was.

The window in 2011 is actually October through December. Exactly where in that window we want to be has yet to be determined. It is also based on landing site, what latitude we are going to go to, and so that will help us pick what day we want to go.

So, when you want to get there is when you want to launch. So we are going to have to back that up. My guess is it is probably in the late October to maybe early November time frame, but we will find out exactly after the project does their work for navigation.

MODERATOR: Back to Headquarters, right down here, please.

MEDIA QUESTIONER: Thanks. Eric Hand with Nature. I have a two-part question with a quick first part for Administrator Griffin.

Did you considering canceling MSL?

ADMINISTRATOR GRIFFIN: No, I didn't, not at all.

Before I would cancel something, first of all, I would have to believe that the project was going badly in a technical sense, I mean as a very first step, and you know, it's not. It's going great.

I know and have personally worked with in my own past, the folks who are doing it, and there are no better folks in the world.

When you are doing things that have never been done before, you are likely to encounter difficulties, and they are almost always unforeseen because if you had foreseen them, you would have taken care of it earlier, but the fact that we are having some troubles, particularly with these motors, but just a backlog of unresolved work is not a surprise but also not a cause for cancellation.

I need to continue for just a little bit. If we

canceled everything on those grounds, we would have never finished Hubble. I worked on Hubble. I always say I am proud to say that I have worked on Hubble, and I am, but we didn't come within a factor of 2 of 300 percent. And does anybody today out there in the science community or those who watch the science community regret building Hubble? We didn't come within a factor of 2 on COBE, Nobel Prize-winning science.

You know, I'm hard put to think of any mission we ever do, unless you are just building cookie-cutter copies, and nobody is interested in that. We know how to control cost. Just build more of what you built the last time, but nobody cares.

So some of the things NASA has done, of which we and the nation and indeed the world are the most proud, are things where we had far more troubles than we are having on Mars Science Lab, to be very honest with you. So, no, I didn't give any thought to canceling the mission.

MEDIA QUESTIONER: My follow-up, I guess for you or Dr. Weiler.

You could argue that something like Hubble supports a much broader set of science goals and a much

broader scientific community. MSL goes to one landing site and supports a very specific science community.

So, as the consequences, as this \$400 million spreads first through the Mars program, then through Planetary Sciences, and probably even into the Science Mission Directorate, how do you respond to the anger and frustration of the broader science community that is going to see a once-diverse program being reduced to a single mission with money going to a single place at JPL?

ADMINISTRATOR GRIFFIN: I am going to start out with the answer to that by saying when you talk about the goals of something like Hubble being broader and more diverse, that is, I guess, only if you don't think that the question of biological life on other planets is a very significant question.

I will remind you again, you know, the fundamental purpose of Mars Science Lab is to explore the possibilities for microbial life and conditions for microbial life, did they ever exist on Mars, or do they exist now.

The potential for the existence of life in places other than the Earth is one of the fundamental questions of

our age, and if that doesn't qualify as being sufficiently broad and diverse, sorry.

Now, Ed?

[Laughter.]

DR. WEILER: As usual, very hard to follow, but let me take the other side of your coin.

A lot of people come to Washington and think they know all the answers. I'm not one of them. I have only been here 31 years. I routinely go to the community. I will go to the community that will be affected. I will ask them, "Here are the options. How much do you all really want the goals of the Mars program, including MSL? This is what it will take. Option one, delay this favorite mission of a few people. Option two, delay this one, or cancel it."

I personally don't think the planetary community, when they have to face each other together in a room, not writing on some, you know, anonymous letter somewhere, if they have to face each other and make that decision, I will bet you they will choose Option A, B, or C, and that won't be cancellation. I may be wrong.

But let me clear up one thing too, just because

there's a lot of math that's been thrown around. It is \$400 million in '10 and '11 to complete the program, but we are also not spending the \$200 million we would have had to spend to get to launch. So you can do your own math on that, whether it is 400 or additional 200, et cetera, but if we had gotten to launch, to get to launch, if Mike and I had made the decision the next January to go forward to 2009, we would have had to find 200 extra million dollars.

We will not do that now. That is the good news. The bad news is we have to find 400, but it is over fiscal '10 and '11. So I just want to make that clear because there's been a lot of numbers thrown around.

MR. McCUISTION: Can I make a comment there? I hate to correct my boss in public, but the \$400 million actually --

DR. WEILER: I'm used to that.

[Laughter.]

MR. McCUISTION: Okay. The \$400 million actually is from 2010 through 2014. It is over a five-year period.

It is finishing the development and adding operations in years that operations didn't exist. So it is actually, if you look at fiscal, you know, per-year realities, it is not

nearly as painful as \$200 million in one year that we are already partially through.

I want to add one more science comment too. Mars Science Laboratory is not purely a Mars mission. Mars Science Laboratory, as Mike said, actually is a planetary science mission. It is much broader than just that. It is geology. It is geochemistry. There's geophysics, a little bit, astrobiology. It covers a lot of disciplines. Mars is the only place in the solar system that actually can fill in an easily accessible way all of the Decadal Survey goals for scientific exploration of the solar system.

So pitting Mars community against the rest of the planetary community is really inappropriate, and so, if you separate this as, well, Mars is the little community that we are serving, it is really inappropriate. It is just not an appropriate characterization and not an accurate characterization.

MR. ELACHI: Maybe one additional thing, as long as we are adding additional things, and it is not the only mission --

DR. WEILER: You are going to correct me on something?

MR. ELACHI: Sorry. No, no. I am adding.

DR. WEILER: Oh, okay.

[Laughter.]

MR. ELACHI: It is not the only mission to Mars.

NASA recently selected MAVEN, which is also a mission which will be launched in 2013.

MODERATOR: Okay. We have got a telephone question now. I think it is Frank Morring from Aviation Week. Frank?

MEDIA QUESTIONER: Thank you. This is for Ed Weiler.

On the initiative with the European Space Agency, could you tell us a little bit more about how that is going to proceed, what sort of time frame you are working to for a sample return mission? And also, could you just refresh my memory on where the idea of caching out of Mars Science Lab and also the ExoMars Rovers stands right now? Thank you.

DR. WEILER: Okay. I will leave the last three or four or five parts of that question to Doug. You start with the cache business.

MR. MCCUISTION: Okay.

DR. WEILER: Okay. Yeah, it's easy to talk about what we talked about yesterday because the idea was born in July, and it was solidified yesterday. No, there isn't a lot of meat on the bone, other than David and I at the top of our two science parts of our agencies have agreed that, you know, we got to keep fooling ourselves. Nationalism is great. You know, it is nice to put our logos on our missions, but these missions are getting complex and expensive.

We have the same scientific goals. They want to send Rovers to Mars. They want to do a sample return. They want to search for life. The goals, I mean, not surprisingly, Western Europe and the United States seem to think alike when it comes to science on Mars. Isn't this the right time, especially now, especially now considering that the 2016 mission ideas are now up in the air because those missions will be impacted?

ESA has some ideas for a mission in 2016. We could probably do a heck of a lot better mission if we did it together than if we continue to compete with each other.

We got technologies and knowhow that they don't. They've got technologies and knowhows that are special.

Let's work together. What a thought, and this just solidified. I mean, we kind of reached the decision without much thought. It was kind of a no-brainer yesterday, as I reflected to David what we were about to tell you today.

What was the second part of the question before the cache business?

MR. McCUISTION: It was an MSR timing question.

DR. WEILER: Oh, MSR. David and I are both realists. We recognize that scientists like to say missions will cost X, and then by the time the engineers touch them, they are X times 2, or by the time the cost analysts get involved, it is X plus 3.

A sample return mission is not going to be done for \$3 billion or \$4 billion. That is like saying JWST could be done for a billion.

When the experts look at a sample return mission, the number comes out between 6- and \$8 billion, and that is not surprising considering what our Rover is going to wind up costing. Remember, the Rover goes and lands on Mars. That is hard enough. A sample return mission, we got to go to Mars. We've got to land. We've got to have a rocket

that takes off. It's got to rendezvous with an orbiter. It's got to give it some samples. Then it has got to get to the Earth, and it's got to land safely. Other than that, it's a piece of cake. Right?

[Laughter.]

DR. WEILER: This is going to be a significant mission, and the way to plan a mission like that is not saying it is going to cost \$3 billion, go do it. That is certainly one management style, but hope and luck is not a management tool, as Mike likes to remind us on many occasions.

So David and I both agree that this is probably in the range of 6- to \$8 billion to do it properly, with the proper testing and technology program before we do it, and that we ought to do it together as a U.S.-Western European mission, and probably looking at the kinds of budgets we might expect, considering the economic situation in the world right now, you know, it's probably in the 2020s, early 2020s as the best we could probably do, but we think that is a realistic date with a realistic cost.

Do you want to take the cache question?

MR. MCCUISTION: Yeah. I am going to expand or

add to a little bit of what you just said internationally.

There is a very strong global Mars exploration community already. There is an organization that has been in existence for six or seven years called the International Mars Exploration Working Group, which is managers from around the globe at my level that meet every six to 12 months to strategize how missions can work cooperatively together to expand the scientific knowledge of the planet. We have very good relationships with Europeans on Mars Express. They have supported Phoenix for us. We have supported them in certain things. We have missions. We share instruments all the time. So that global community works pretty well already.

That International Mars Exploration Working Group, a year and a half ago, chartered a group called iMARS that reported back to the IMEWG, as we call it, who studied international Mars sample return. So this move that Ed and David put together to actually expand the cooperation, we have already got a phenomenal framework of cooperation at the engineering and management level globally for Mars.

We had 12 nations in that organization that all

wanted to participate, and it has been quite spectacular. So I think that the underpinnings politically and socioeconomically were already there. So this works well, and the common goal is sample return. Globally, the common goal is Mars sample return, and we all know we can't get there by ourselves. So we are going to keep that going.

That moves us clearly to cache, the cache. There was a cache that the previous Administrator, Associate Administrator asked us to put on MSL. It was built. The guys and gals at Ames Research Center did a nice job and delivered us the hardware.

Some of the things, many of the things that we had learned about Mars from Phoenix and handling samples from Phoenix showed that we actually needed cleaning tools for our sample systems on MSL. So there is very little real estate, even though this Rover is huge. There is very little real estate when it left, when you look at observation trays and spare drill bits, and where the arm can actually reach and see. We needed the space that the cache was taking up for a cleaning system for our sample handling.

The other is the science community has evaluated

this, and it is certainly unclear that the way the samples were going to be handled were actually going to support the astrobiological needs of the community and where the program, follow the water and hunting for habitats and things, is going to take us. So the cache is no longer on MSL, and it will not be.

I know that is going to be the next question, so I will just say it. It won't be added back on because we are not going to add things back to this mission at this point in time.

The question also included ExoMars. We offered this cache to the Europeans about a year and a half ago, and because of the storage techniques and also a real estate problem on ExoMars, they declined that offer, and so there is little chance, I believe, that ExoMars will have a cache of any type.

The mid-decade missions and the '16 and '18 time frame in the process of moving towards sample return, however, that, as well as precision landing and improved sample handling and coring, are some of the key technologies you want to put in place, but those will be cored samples. They will be hermetically sealed samples,

retrievable sample qualities to prove that we can actually do that.

So I think those were all the questions in that list.

MODERATOR: Okay. We are still on the phone bridge. Now we have got Rachel Courtland from New Scientist next.

MEDIA QUESTIONER: Hi. I was wondering whether you anticipated that adding the brushes would impact your schedule at all before you decided to delay or whether you were expecting you would be able to sort of push it under and get the Rovers set for a 2009 launch.

MODERATOR: Could you repeat the first part of your question, please, Rachel?

MEDIA QUESTIONER: I am wondering how eleventh hour, your decision to add the brushes was and whether you are expecting you would be able to make a 2009 launch with the new brush requirement.

MR. McCUISTION: Yes, it was a late decision. Actually, it came out of -- as I said, what we found out about Phoenix on the surface which, as you know, just recently the mission ended, we learned a lot over the

summer about the soil consistencies and handling of those soils. So we had the Phoenix team get together with the Mars Science Lab Sample Handling and Processing Team to look at lessons learned from that, and that is where that requirement came from, and I believe that that meeting was probably in the October time frame.

It is a crucial piece of equipment. It is fairly simple, we believe, but that design is actually being built or designed right now.

It should have no effect. We didn't think it would have an effect on the '09 launch, and I still don't believe it would because it is an externally mounted device. It doesn't have motors or anything in it, to the best of our expectations, and so it should have no effect on the '11 launch either, which I think was the tail end of that question.

MODERATOR: Okay. One more phone call. Ken Kremer from Spaceflight magazine.

MEDIA QUESTIONER: Hi. Thank you. Yes. I have a question for Doug about the instruments.

You talked about Phoenix. Are you going to make any change at all as a result of what you landed, and for

Ed Weiler, ExoMars, are you saying that is definitely a joint mission now? ESA recently delayed it, and I guess many were wondering whether it would really be a mission anymore. So are you going to work with ESA on that? Will it be replanned? Thank you.

MR. MCCUISTION: I believe, if I understood the question right, are there going to be any other changes to the MSL instruments based on what we learned on Phoenix. Those meetings between the Phoenix handling team and the MSL team need to continue. We want them to continue, and if they identify changes that are manageable -- and I mean that from a technical, as well as a financial perspective -- we will certainly make those changes, if that is appropriate.

We were surprised in a number of areas on Phoenix, and we don't want to be surprised again. So we want to prepare for those kinds of things.

DR. WEILER: Doug, help me with ExoMars, but, again, we are at the very, very early stages. ExoMars is, you know, obviously a program that has been underway for a while. It is planned for a launch in 2016.

We had a very short discussion yesterday on some

ideas of how we could work together on ExoMars. They are literally at the Vugraph stage at this point in time, and I think we both learned not to make too many plans based on PowerPoint. So it is going to take some real scientists and engineers getting together and working on that, but is there a possibility it could be a joint mission?

Absolutely.

ADMINISTRATOR GRIFFIN: We are certainly open to that.

DR. WEILER: And we are certainly open to it and welcome it.

MODERATOR: Okay. Let's take one more phone question, and then we will come back here to Headquarters. This on the phone is Emily Lakdawalla.

MEDIA QUESTIONER: Hi. I have two questions. The first one is I am wondering if two years of decay of the plutonium and the RTG will result in any further limitations to the Rover's operations. I know that the traverses were already going to be power-limited.

MR. MCCUISTION: This is Doug McCuistion.

We don't expect any real degradation. We will see a percent or two a year, which isn't significant, and

we will consider not fueling the flight RTG for a little while, but the decay rate is really kind of insignificant.

MR. ELACHI: Five percent total.

MR. McCUISTION: Five percent total is what Charles just said. So that is about right, a couple percent.

MR. ELACHI: Yeah.

MODERATOR: Okay. I have got one more phone. So let me go to that, and we will clear that out and then come back. Steve Clark from Spaceflight Now.

MEDIA QUESTIONER: Hey, one more question about the actuators, and then I have another follow-up as well.

Have the actuators actually been delivered to JPL, and is it just a matter of the life-cycle testing that you mentioned, or are there more developmental problems you have to deal with first?

MR. McCUISTION: As I mentioned, there were 31 actuators on the Rover. One flight actuator has been delivered. However, the implications of some of these current technical issues, we're not sure if it affects that one or not yet.

I mentioned 45 engineering model units. Nineteen

engineering model actuators have been delivered to date.

So there are still technical challenges. None of these are technology challenges. These are basically engineering and throughput challenges, and we will figure these out. We just need the time to do it, and we need to have the time to test the Rover and the systems that these actuators go into.

So I don't know if there are other lurking problems. I would hope not, but these have been pretty well rung out.

Life test is another story. We have to have life tests, as I mentioned before, and we have not yet started that because we need reliable actuators before we start the life tests. Understand these are actually going to make the two-year mission life expected.

MR. ELACHI: Let me add two things. Like all good engineers, even if you have 15 which are good and then one has an anomaly, you immediately have to go and look at the other 15 to make sure that this anomaly will not appear at some later time.

The other one, as Doug said earlier, it is not only the actuator, but then these actuators have to go into

an arm or in a motor. We have to test them, how they operate. We have to test the software which goes with them. So it is a complete package that we have to look at, and that is where we started getting concern as an independent authority and the team, that by doing that, we are eating into the test time that is necessary to understand every little quirk that the Rover to the lander or any of these would have. And that is what led us to the conclusion that it would be the wise thing to delay this mission.

MODERATOR: Okay. Let's come back to Headquarters, please.

MEDIA QUESTIONER: SpaceNews.

Was it a consideration ever to launch in 2010, park and solar orbit and then do a flyby and pick up at the 2011 opportunity, and if you resolve these issues, could you come back and decide to do that?

DR. WEILER: I will take a first shot at that. That idea, I think I should be blamed for that. I suggested it to somebody about December of last year, and I was, admittedly, shooting from the hip. It sounded good to me, you know, get it off and let it sit in orbit, it has

got to be cheaper.

But when I got back here, six months ago, and we started looking at these options, being somewhat of a scientist, when presented with data that showed it was a bad idea, I gave up on it.

S, Doug, why don't you tell he about the data.

MR. MCCUISTION: Some of the issues with that is all you do is, like you say, you park in an Earth orbiting trajectory, and then you pick up the 11 trajectory and land at the same time anyway. It sounds good.

The issues related to that are the system was not designed to do that. So that Cruise Stage that I showed was designed for nine months in cruise. It would spend almost two years in cruise. So there is a reliability issue with that, which may result in upgrades or even potentially redundancy in certain systems.

We would actually have to change antenna patterns on the Cruise Stage because it was never designed to communicate with Earth. It goes one way. It goes to Mars.

It doesn't come back and do a loop around the Earth, and so there were design changes to the Cruise Stage that are going to have to be done.

And then, of course, carrying an MMRTG, coming back here, creates another issue, that we didn't want to get into that. It is just not worth the difficulties and the analyses, which are quite expensive and extensive related to that.

And then the budget profile, which is not really the right reasons -- and this is really more of the technical rationale that pushes us out of '10, but the budget reasons are that we now impacted '09 budget again. So we still have to come up with a huge amount of money, probably still on the order of a couple hundred million in 2009, which creates a difficulty since we are already in 2009. So it is a challenging financial environment.

ADMINISTRATOR GRIFFIN: Well, it is a difficult for which we got no return.

MR. McCUISTION: And we got no return.

ADMINISTRATOR GRIFFIN: If you would get something for it, we might have -- when we thrash through all of this, if you would get something in return, you might be willing to do it, but we didn't get anything out of it.

MR. McCUISTION: There was no real return on that

investment. There was more design work and changes, and it just didn't make sense.

MODERATOR: Okay. We are a little bit past our time. So we will take a couple more.

MEDIA QUESTIONER: This is Mark Mathews with the Sentinel again.

Just listening over the last hour, it is pretty clear that you guys know that we know that NASA has a history of being over budget and being late on projects. Now, there's a good number of reasons for this, that you guys are doing things for the first time, you have optimistic scientists, but why does this keep happening? Why is there a continued pattern of late and over-budget projects?

I mean, NASA has been in the high-risk list for the GAO for 18 years. So why does this keep happening?

ADMINISTRATOR GRIFFIN: Well, we are always going to be on the high-risk list for the GAO because they are not doing what we are doing.

You have answered the question yourself. We are doing things for the first time. I would ask you, when is the last time you did any sort of a project, a

do-it-yourself project at home, and did you have to make an extra trip to the store to pick up something you forgot, or did you break anything that you in retrospect shouldn't have broken?

MEDIA QUESTIONER: I'm spending my own money.

ADMINISTRATOR GRIFFIN: And we are spending your own money for this.

[Laughter.]

ADMINISTRATOR GRIFFIN: As thoroughly discussed, carefully vetted by the Congress, each and every year, it has been determined as a matter of national policy that it is a good idea for the United States to operate on the frontiers of science and technology, that we get something out of it, that we value for the long term.

It doesn't come free, and if we already knew how to do it, it would not, by definition, be on the frontiers of science and technology.

We start these things out, and we admit up front we don't completely know how to do them. That is what makes them interesting.

My favorite quote of President Kennedy's, "We do these things not because they are easy but because they are

hard."

So I look in retrospect -- and I have looked carefully. We all have, but I have in particular looked carefully at what the folks who are working on Mars Science Lab have actually done, and even in retrospect, they haven't done anything wrong. They did not do as good a job as we might hope of estimating what was required to get to the goal line, but their progress toward the goal line has not been -- has not been a history of mistakes. In fact, they are doing really well.

So if we are to judge the worth of our work by our ability to estimate, then that is a standard I am not ready to apply or to accept. Our ability to estimate what it is going to take to do a job has got to be separated out from our ability to do the job, and I think the Mars Science Lab team is doing quite well.

MODERATOR: Okay. We will have Seth next.

MEDIA QUESTIONER: Seth Borenstein, AP, again for Administrator Griffin.

You talked about how scientists often under budget, under -- downplay the prices when they are selling it to NASA, selling it to the community.

ADMINISTRATOR GRIFFIN: And NASA picks off the list of community priorities and the competition within the community. To be first on the list of a given Decadal Survey is fierce and is driven by price. Yes.

MEDIA QUESTIONER: So, given that this Decadal Survey that MSL was on, it was listed as a medium cost, under \$650 billion in the Decadal Survey. That was just five years ago. Is there some blame at the National Academy or the scientists for underbilling this or at NASA for accepting this underbilling? I mean, how many times do you have to be -- the question is, at what point do you say okay, you know, this is -- we know these numbers aren't going to be real? I mean, do you go into that saying that?

ADMINISTRATOR GRIFFIN: We do, of course.

Let me -- I am going to surprise the science community and defend them on this.

[Laughter.]

ADMINISTRATOR GRIFFIN: Let me go through with you the purpose of Decadal Surveys and the purpose of cost estimates as we try to get them.

The purpose of the Decadal Surveys is to get from the best working-level scientists in the world, what their

mission priorities would be to accomplish the scientific goals of the moment.

Generally, at NASA, we participate in those things. We absolutely have some world-class scientists, but NASA as an institution doesn't really put fuzz on the Decadal Surveys. We work with the people who prepare them.

We might not fly the number-one priority if we don't have the budget to do it, but we certainly understand it, we respect it, and we don't try to spin it.

Now, there is not a really good way early -- when you are very early in mission formulation at the Decadal Survey stage, there is not a really good way to get an independent cost estimate that anyone would believe, and so the previous questioner said why does this keep happening.

It is because there is not a really good way to estimate on the very front end of a mission, what it is going to take to accomplish these scientific priorities, even if no one was competing.

And then, of course, in an environment where there is, in fact, some dependence on the selection of mission priorities on what those will cost, there is a tremendous pressure on all of the different scientific

teams advocating different priorities to demonstrate that, as I sometimes say, "I can name that tune in two notes."

Now, that pressure sort of actually levels out across all of the missions on a Decadal Survey. So we are probably best off if we take the priorities from the Decadal Survey as being relatively good, but don't attach too much weight to the cost.

So what I have been trying to do here at NASA with the team that has to implement these is to put in place better independent cost estimation techniques and more of them and more adherence to them.

The James Webb folks, the folks who did the independent cost estimate, for example, on James Webb would tell you that they predicted essentially the cost that was later found to be the case. That wasn't the cost the mission was sold at because the proponents of the mission said, "Naw, the independent cost estimators have got their head in some untimely place. We know it is only going to cost \$2.2 billion, and the independent cost estimators are saying it is going to be 3.5. And they are wrong, and we are right." Well, guess what? It didn't turn out that way.

So I have been trying to -- and we are -- not just trying, we are succeeding, I think, in putting more rigorous methodologies for independent cost estimation in place at the agency, but we don't have and no one has -- no one has the resources to apply those methodologies to every mission on the Decadal Survey list, and there are several Decadal Survey lists.

You have to actually being designing the mission at some substantial level of detail before you have the input data that the cost methodology guys need. So you really can only get a valid, useful, intelligent independent cost estimate after you are fairly well down the road, which is why Doug McCuistion earlier made the point that the agency doesn't commit to, the Congress doesn't believe -- and shouldn't -- any budget estimate which is made before we have a confirmation review.

Mars Science Lab was not confirmed at whatever the early number was, something under a billion. Mars Science Lab was confirmed at 1.65, 1.63.

So I'm sorry for the long-winded answer, Seth. You always ask good questions, and the truth is I actually really don't know how to take a set of missions on a

Decadal Survey and attach a cost number to those missions that somebody would believe for the purposes of prioritizing them.

So we prioritize by scientific priority. We do try to get a Kentucky Windage on what the cost is going to be, but we have to go well down the path on mission design before even the best people in the world can give you a cost you'd believe, and that's just the truth.

MEDIA QUESTIONER: Can I add a little, one more thing?

ADMINISTRATOR GRIFFIN: I'd rather not. Let's move on. We are running out of time. Sorry.

MEDIA QUESTIONER: No problem.

MODERATOR: Okay. Mark.

MEDIA QUESTIONER: Thank you.

We know that from what you have said that there will be additional cost as a result of the delay. Are there any other costs, scientific costs in terms of having this delayed, in terms of the progress of planetary science exploration, other missions that might be going from NASA or elsewhere around the world? Are there any losses as a result of that?

DR. WEILER: Of course. I mean, we would have liked to have launched in 2009, followed up with our Mars Scout in 2013, and then a 2016 mission. That is going to have to be re-looked at that. Maybe we will still have a good Mars 2016 mission because we do it and consort with the European Space Agency. So, hopefully, that will alleviate some of the impact to the Mars science program ultimately, looking at the world view.

There will be impacts. I can't tell you exactly what, but we will probably have to delay a major planetary mission to come up with the cost. But again, we will not do that without full and open disclosure with the scientific community. That will be affected through the independent review process that is already in place under the NASA Advisory Committee. So we will do that and consort with them.

There will be impacts. Science will be delayed. We don't want to cancel science, however. I don't want to take that option there.

However, if a group of scientists that are authorized to give us such advice tell us to cancel MSL, then it is something we will have to consider, but there

are other stakeholders obviously, too. We haven't mentioned that Congress is a stakeholder, the OMB is a stakeholder, the White House is a stakeholder. They also have a role. So perhaps the science community won't be the final word, whatever advice we might get from them.

MODERATOR: Okay. Final question, Keith.

MEDIA QUESTIONER: This is Keith Cowing, NASAWatch. I am going to parse my questions by fashion here for the guys in ties.

First, an observation.

[Laughter.]

MEDIA QUESTIONER: You're welcome.

In 2001, Ed, I think you were standing right here, and I asked you about these two little Rovers. And you with all honesty said, "You know, Keith, they are going to be covered with dust, and those little critters are going to be dead. That is why we have two of them." Squires is nodding. Nobody thought that these amazing things would keep going.

You reprogram spacecraft that are 35 years old, outside the solar system, and yet Dr. Griffin with frustration here says that every time we do something like

this, the cost estimation is something, it is, A, being done for the first time and, B, it is still vexing, that you can't nail us down.

That said, this keeps happening. Is the answer bigger reserves, we just have a bigger bucket, and just up front say, "Hey, I swear right now I am doing my darnedest, but it is going to cost overrun. I need a bigger bucket," or is there some other tool that you have never been given, some lightning bolt or piece of software that can just break this weird symmetry here?

ADMINISTRATOR GRIFFIN: Let me start. It is not really weird. I frankly expect it, and to provide a bigger reserve just creates a self-fulfilling prophecy.

We don't want to spin the answers, and despite what people sometimes think, we don't.

I know more than your average administrator about cost estimation methodologies actually, and we truly have some people at this agency and have had people at this agency who are very good at it. There are industry-standard tools and methods, and we have them and use them.

But after you feed in everything you think you

know, if you will, to the cost estimation box and you get out an answer, what is your rationale for spinning the number? I mean, you fed in everything you know. If you change the answer that comes out, well, you are just making it up, and we don't want to do that either.

Now, what usually happens to us is that things we didn't know about when we started have to be done. We do them because the alternative would be failure, but they weren't anticipated at the start, and so they cost more.

It wasn't as much a failure. I don't want to sound as if in my prior answers or this one as if I am blaming the cost estimators for not having good methodologies. That is not fair. They do, but they can only estimate the cost of things and processes that we know we are going to need, and if in the process of designing a mission, as almost always happens, we discover that we didn't have it totally figured out on the front end, then we have to do the things that come up, and they cost money. So that is where we get into difficulty.

Now, it would be nice. Honestly, your question is a good one. In a perfect world, I would love to start a project out with a big bucket labeled "Reserves," but the

OMB doesn't like that, and the Congress doesn't like that, and the reason that they don't like that is entirely reasonable from their perspective because that represents money on the table which is not being utilized in the furtherance of other goals. You have left it in the reserve bucket, and that means it is not being applied in the moment. As long as it is sitting in the reserve bucket, it is not being applied to other national goals, and their view directly expressed is if you need more money, come back and tell me that you need more money and tell me why, but I am not going to give it to you in advance. And you know, as a taxpayer, I'm not sure that's wrong.

So some of this stuff comes out to saying we are really working it hard. We have got experts. They are doing the best they can, and there are limitations on just how well humans can do. And today, you are seeing that we estimated wrong.

Now, it's kind of interesting. The first meeting I had out at JPL after I took this job, Charles pointed out to me that Mars Science Lab was a project aggressively trying for '09, but it was aggressive, and the first thing

I said to him was, "Well, tell me if you get in trouble, the first minute that you do." And he has been 110-percent straightforward from day one about where we stood on MSL, and we always said if we get to a point where we don't think it is prudent to continue, we will slip to '11, and we are telling you that this week, we got to that point.

MODERATOR: Okay. That will wrap it up for today. Thanks to everybody who took part, and for more information on this and other NASA missions, check the website [www.NASA.gov](http://www.NASA.gov). Thanks for joining us. Have a great afternoon.

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